

FIGURE 1

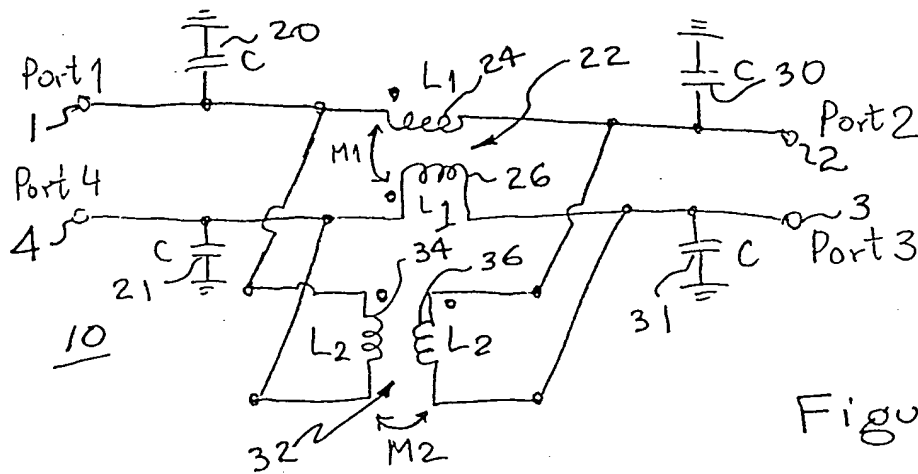


Figure 2

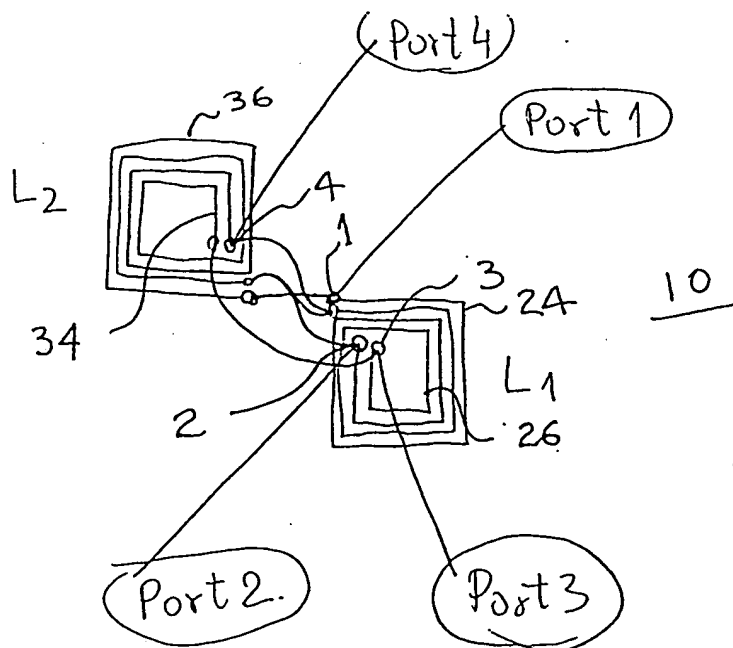


Figure 3

Simulation of the coupler from the Figure1, L=28 nH C=11 pF  
 Center of the operating frequency: Fc = 146 MHz

FREQ-MHZ	DB[S11]	DB[S22]	DB[S21]	DB[S31]	DB[S23]	ANG[S21]	ANG[S31]
10.0000	-35.455	-35.455	-25.823	-0.014	-34.986	86.676	-2.986
20.0000	-29.573	-29.573	-19.831	-0.056	-29.104	83.382	-5.960
30.0000	-26.285	-26.285	-16.355	-0.124	-25.815	80.139	-8.912
40.0000	-24.117	-24.117	-13.915	-0.217	-23.647	76.970	-11.837
50.0000	-22.614	-22.614	-12.045	-0.334	-22.144	73.886	-14.737
60.0000	-21.581	-21.581	-10.534	-0.473	-21.111	70.890	-17.619
70.0000	-20.925	-20.925	-9.266	-0.632	-20.454	67.974	-20.500
80.0000	-20.608	-20.608	-8.170	-0.813	-20.137	65.120	-23.403
90.0000	-20.633	-20.633	-7.201	-1.017	-20.161	62.297	-26.359
100.000	-21.048	-21.048	-6.324	-1.248	-20.576	59.460	-29.407
105.000	-21.434	-21.434	-5.913	-1.376	-20.961	58.020	-30.979
110.000	-21.969	-21.969	-5.517	-1.513	-21.496	56.553	-32.588
115.000	-22.690	-22.690	-5.134	-1.662	-22.217	55.052	-34.242
120.000	-23.655	-23.655	-4.765	-1.824	-23.181	53.506	-35.944
122.000	-24.128	-24.128	-4.620	-1.893	-23.655	52.873	-36.639
124.000	-24.663	-24.663	-4.477	-1.965	-24.190	52.231	-37.343
126.000	-25.272	-25.272	-4.336	-2.039	-24.798	51.578	-38.055
128.000	-25.967	-25.967	-4.197	-2.117	-25.494	50.915	-38.777
130.000	-26.769	-26.769	-4.060	-2.198	-26.297	50.240	-39.507
132.000	-27.704	-27.704	-3.924	-2.282	-27.232	49.553	-40.246
134.000	-28.810	-28.810	-3.791	-2.370	-28.340	48.853	-40.994
136.000	-30.143	-30.143	-3.659	-2.462	-29.675	48.140	-41.751
138.000	-31.790	-31.789	-3.529	-2.558	-31.328	47.412	-42.517
140.000	-33.894	-33.894	-3.401	-2.658	-33.447	46.670	-43.290
142.000	-36.701	-36.701	-3.276	-2.764	-36.291	45.913	-44.071
144.000	-40.454	-40.455	-3.153	-2.874	-40.175	45.140	-44.860
146.000	-43.250	-43.249	-3.031	-2.990	-43.249	44.351	-45.654
148.000	-40.149	-40.149	-2.913	-3.112	-39.949	43.545	-46.454
150.000	-36.028	-36.028	-2.797	-3.239	-35.680	42.723	-47.259
152.000	-32.857	-32.857	-2.684	-3.374	-32.454	41.883	-48.066
154.000	-30.390	-30.390	-2.573	-3.515	-29.963	41.026	-48.875
156.000	-28.385	-28.385	-2.466	-3.663	-27.945	40.151	-49.684
158.000	-26.697	-26.697	-2.362	-3.819	-26.250	39.259	-50.491
160.000	-25.239	-25.239	-2.262	-3.984	-24.786	38.350	-51.292
162.000	-23.954	-23.954	-2.165	-4.156	-23.498	37.423	-52.087
164.000	-22.804	-22.804	-2.072	-4.338	-22.346	36.480	-52.871
166.000	-21.765	-21.765	-1.982	-4.529	-21.304	35.521	-53.641
168.000	-20.815	-20.815	-1.898	-4.730	-20.353	34.546	-54.393
170.000	-19.942	-19.942	-1.817	-4.942	-19.479	33.557	-55.123
175.000	-18.028	-18.028	-1.636	-5.518	-17.563	31.026	-56.819
180.000	-16.415	-16.415	-1.487	-6.166	-15.948	28.429	-58.252
185.000	-15.033	-15.033	-1.372	-6.892	-14.565	25.790	-59.306
190.000	-13.841	-13.841	-1.292	-7.695	-13.372	23.137	-59.834
195.000	-12.808	-12.808	-1.248	-8.571	-12.338	20.501	-59.655
200.000	-11.912	-11.912	-1.239	-9.507	-11.441	17.914	-58.555

FIG. 4

# FIG. 5A

Simulation of the coupler from the Figure1, L=1.98 nH C=0.8 pF  
 Center of the operating frequency: Fc = 2 GHz

FREQ-MHZ	DB[S11]	DB[S22]	DB[S21]	DB[S31]	DB[S23]	ANG[S21]	ANG[S31]
100.000	-37.954	-37.954	-28.522	-0.007	-37.911	87.616	-2.152
200.000	-32.006	-32.006	-22.517	-0.030	-31.963	85.214	-4.299
300.000	-28.606	-28.606	-19.021	-0.067	-28.563	82.852	-6.437
400.000	-26.279	-26.279	-16.556	-0.118	-26.236	80.512	-8.563
500.000	-24.564	-24.564	-14.659	-0.183	-24.521	78.214	-10.674
600.000	-23.256	-23.257	-13.122	-0.260	-23.214	75.960	-12.771
700.000	-22.250	-22.250	-11.835	-0.350	-22.208	73.752	-14.854
800.000	-21.484	-21.484	-10.728	-0.452	-21.441	71.591	-16.929
900.000	-20.922	-20.922	-9.759	-0.565	-20.879	69.471	-19.000
1000.00	-20.544	-20.544	-8.895	-0.689	-20.501	67.392	-21.076
1050.00	-20.420	-20.420	-8.495	-0.755	-20.378	66.366	-22.119
1100.00	-20.341	-20.341	-8.114	-0.825	-20.298	65.343	-23.167
1150.00	-20.306	-20.307	-7.749	-0.897	-20.264	64.326	-24.223
1200.00	-20.317	-20.317	-7.400	-0.973	-20.275	63.311	-25.286
1250.00	-20.377	-20.377	-7.063	-1.052	-20.335	62.295	-26.361
1300.00	-20.488	-20.488	-6.739	-1.134	-20.445	61.278	-27.448
1350.00	-20.654	-20.654	-6.425	-1.221	-20.612	60.255	-28.549
1400.00	-20.881	-20.881	-6.120	-1.312	-20.839	59.227	-29.667
1450.00	-21.178	-21.178	-5.825	-1.408	-21.135	58.187	-30.803
1500.00	-21.553	-21.553	-5.538	-1.509	-21.510	57.135	-31.960
1550.00	-22.021	-22.020	-5.258	-1.615	-21.978	56.064	-33.139
1600.00	-22.599	-22.599	-4.984	-1.729	-22.557	54.972	-34.343
1650.00	-23.314	-23.314	-4.718	-1.850	-23.273	53.855	-35.573
1700.00	-24.202	-24.202	-4.457	-1.979	-24.160	52.712	-36.830
1720.00	-24.620	-24.620	-4.355	-2.033	-24.578	52.244	-37.341
1740.00	-25.077	-25.078	-4.253	-2.089	-25.036	51.772	-37.857
1760.00	-25.584	-25.584	-4.152	-2.146	-25.542	51.294	-38.378
1780.00	-26.143	-26.144	-4.053	-2.205	-26.103	50.810	-38.903
1800.00	-26.770	-26.770	-3.954	-2.266	-26.729	50.320	-39.433
1820.00	-27.473	-27.473	-3.856	-2.329	-27.433	49.823	-39.967
1840.00	-28.270	-28.270	-3.760	-2.394	-28.229	49.319	-40.507
1860.00	-29.184	-29.184	-3.664	-2.461	-29.144	48.809	-41.051
1880.00	-30.243	-30.243	-3.569	-2.530	-30.204	48.291	-41.599
1900.00	-31.503	-31.503	-3.476	-2.601	-31.464	47.765	-42.152
1920.00	-33.028	-33.028	-3.383	-2.675	-32.990	47.233	-42.710
1940.00	-34.960	-34.961	-3.292	-2.751	-34.924	46.692	-43.272
1960.00	-37.531	-37.531	-3.202	-2.830	-37.496	46.143	-43.837
1980.00	-41.351	-41.352	-3.112	-2.912	-41.324	45.586	-44.405
2000.00	-48.656	-48.662	-3.025	-2.996	-48.647	45.020	-44.979
2020.00	-56.268	-56.275	-2.938	-3.084	-56.145	44.446	-45.554
2040.00	-43.561	-43.559	-2.853	-3.175	-43.497	43.862	-46.133
2060.00	-38.445	-38.444	-2.769	-3.269	-38.390	43.270	-46.713
2080.00	-35.164	-35.164	-2.686	-3.366	-35.114	42.669	-47.296
2100.00	-32.732	-32.732	-2.605	-3.467	-32.683	42.059	-47.879
2120.00	-30.788	-30.788	-2.526	-3.572	-30.741	41.440	-48.464
2140.00	-29.164	-29.163	-2.448	-3.681	-29.116	40.811	-49.048
2160.00	-27.765	-27.765	-2.372	-3.793	-27.718	40.173	-49.631
2180.00	-26.534	-26.535	-2.298	-3.910	-26.488	39.526	-50.213
2200.00	-25.434	-25.435	-2.225	-4.032	-25.389	38.870	-50.791

2220.00	-24.439	-24.439	-2.155	-4.158	-24.393	38.205	-51.366
2240.00	-23.529	-23.529	-2.086	-4.289	-23.483	37.532	-51.937
2260.00	-22.689	-22.689	-2.020	-4.424	-22.644	36.848	-52.500
2280.00	-21.911	-21.911	-1.955	-4.565	-21.866	36.158	-53.057
2300.00	-21.185	-21.185	-1.893	-4.711	-21.140	35.458	-53.605
2350.00	-19.559	-19.559	-1.747	-5.100	-19.515	33.676	-54.922
2400.00	-18.149	-18.149	-1.617	-5.526	-18.105	31.850	-56.143
2450.00	-16.908	-16.908	-1.504	-5.991	-16.864	29.987	-57.231
2500.00	-15.805	-15.805	-1.408	-6.496	-15.761	28.096	-58.143
2550.00	-14.819	-14.819	-1.330	-7.044	-14.775	26.187	-58.828
2600.00	-13.933	-13.933	-1.271	-7.634	-13.889	24.272	-59.223
2650.00	-13.136	-13.136	-1.231	-8.265	-13.092	22.364	-59.259
2700.00	-12.417	-12.417	-1.209	-8.934	-12.373	20.471	-58.856
2750.00	-11.769	-11.769	-1.207	-9.634	-11.725	18.610	-57.918
2800.00	-11.186	-11.186	-1.221	-10.354	-11.142	16.792	-56.351
2850.00	-10.659	-10.659	-1.254	-11.076	-10.615	15.024	-54.055
2900.00	-10.187	-10.187	-1.302	-11.777	-10.143	13.320	-50.960
2950.00	-9.762	-9.762	-1.364	-12.425	-9.718	11.688	-47.022
3000.00	-9.381	-9.381	-1.440	-12.981	-9.337	10.135	-42.296

FIG. 5B

FIG. 6A

Simulation results for hybrid branch coupler with mutually coupled inductors from Figure 2.

L1= 9 nH L2= 18 nH C = 7 pF M=0.95 \* L

Center frequency 455 MHz

Operational frequency range: 350 to 540 MHz

FREQ-MHZ	DB[S11]	DB[S22]	DB[S21]	DB[S31]	DB[S23]	ANG[S21]	ANG[S31]
10.0000	-6.021	-6.021	-6.021	-6.017	-6.023	-0.639	-3.144
20.0000	-6.023	-6.023	-6.023	-6.006	-6.031	-1.274	-6.287
30.0000	-6.026	-6.026	-6.025	-5.988	-6.044	-1.904	-9.427
40.0000	-6.030	-6.030	-6.028	-5.963	-6.062	-2.526	-12.562
50.0000	-6.036	-6.036	-6.031	-5.931	-6.086	-3.136	-15.691
60.0000	-6.044	-6.044	-6.035	-5.892	-6.114	-3.732	-18.814
70.0000	-6.054	-6.054	-6.038	-5.847	-6.149	-4.313	-21.928
80.0000	-6.068	-6.068	-6.041	-5.795	-6.189	-4.876	-25.032
90.0000	-6.084	-6.084	-6.042	-5.736	-6.235	-5.420	-28.127
100.000	-6.105	-6.105	-6.041	-5.672	-6.287	-5.942	-31.212
120.000	-6.163	-6.163	-6.033	-5.526	-6.410	-6.922	-37.349
140.000	-6.246	-6.246	-6.009	-5.358	-6.561	-7.816	-43.444
160.000	-6.362	-6.362	-5.962	-5.173	-6.744	-8.636	-49.501
180.000	-6.522	-6.522	-5.888	-4.972	-6.963	-9.409	-55.526
200.000	-6.734	-6.734	-5.779	-4.760	-7.227	-10.176	-61.529
220.000	-7.013	-7.013	-5.630	-4.541	-7.544	-10.996	-67.520
240.000	-7.373	-7.373	-5.439	-4.319	-7.927	-11.943	-73.510
260.000	-7.834	-7.834	-5.207	-4.100	-8.392	-13.099	-79.505
280.000	-8.419	-8.419	-4.938	-3.890	-8.960	-14.554	-85.510
300.000	-9.156	-9.156	-4.642	-3.695	-9.661	-16.385	-91.520
320.000	-10.085	-10.085	-4.330	-3.521	-10.533	-18.656	-97.521
340.000	-11.257	-11.257	-4.019	-3.372	-11.630	-21.407	-103.490
360.000	-12.748	-12.748	-3.723	-3.253	-13.033	-24.645	-109.393
365.000	-13.184	-13.184	-3.654	-3.227	-13.446	-25.529	-110.854
370.000	-13.650	-13.650	-3.587	-3.204	-13.887	-26.442	-112.308
375.000	-14.149	-14.149	-3.522	-3.183	-14.362	-27.383	-113.754
380.000	-14.685	-14.685	-3.461	-3.163	-14.873	-28.352	-115.192
385.000	-15.262	-15.262	-3.402	-3.146	-15.426	-29.347	-116.621
390.000	-15.886	-15.886	-3.346	-3.130	-16.027	-30.367	-118.040
395.000	-16.564	-16.564	-3.293	-3.116	-16.681	-31.413	-119.450
400.000	-17.304	-17.304	-3.244	-3.103	-17.398	-32.481	-120.849
401.000	-17.460	-17.460	-3.235	-3.101	-17.550	-32.698	-121.127
402.000	-17.620	-17.620	-3.226	-3.099	-17.705	-32.915	-121.405
403.000	-17.782	-17.782	-3.217	-3.097	-17.863	-33.134	-121.683
404.000	-17.948	-17.948	-3.208	-3.094	-18.024	-33.353	-121.960
405.000	-18.117	-18.117	-3.199	-3.092	-18.189	-33.573	-122.237
406.000	-18.290	-18.290	-3.190	-3.090	-18.357	-33.794	-122.513
407.000	-18.466	-18.466	-3.182	-3.088	-18.530	-34.016	-122.789
408.000	-18.646	-18.646	-3.173	-3.086	-18.705	-34.238	-123.064
409.000	-18.830	-18.831	-3.165	-3.085	-18.885	-34.462	-123.339
410.000	-19.019	-19.019	-3.157	-3.083	-19.069	-34.686	-123.614
411.000	-19.211	-19.211	-3.149	-3.081	-19.258	-34.911	-123.888
412.000	-19.408	-19.408	-3.142	-3.079	-19.451	-35.137	-124.161
413.000	-19.609	-19.609	-3.134	-3.078	-19.648	-35.364	-124.434
414.000	-19.816	-19.816	-3.127	-3.076	-19.851	-35.591	-124.707

FIG. 6B

415.000	-20.028	-20.028	-3.120	-3.075	-20.058	-35.819	-124.979
416.000	-20.245	-20.244	-3.113	-3.073	-20.272	-36.048	-125.250
417.000	-20.467	-20.467	-3.106	-3.072	-20.490	-36.278	-125.522
418.000	-20.696	-20.696	-3.099	-3.071	-20.715	-36.509	-125.792
419.000	-20.930	-20.930	-3.092	-3.069	-20.946	-36.740	-126.063
420.000	-21.172	-21.172	-3.086	-3.068	-21.184	-36.972	-126.332
421.000	-21.420	-21.420	-3.080	-3.067	-21.429	-37.204	-126.602
422.000	-21.675	-21.675	-3.074	-3.066	-21.681	-37.438	-126.870
423.000	-21.939	-21.939	-3.068	-3.065	-21.941	-37.672	-127.139
424.000	-22.210	-22.210	-3.062	-3.063	-22.210	-37.907	-127.407
425.000	-22.491	-22.491	-3.057	-3.062	-22.487	-38.142	-127.674
426.000	-22.781	-22.781	-3.051	-3.061	-22.774	-38.379	-127.941
427.000	-23.080	-23.080	-3.046	-3.060	-23.070	-38.615	-128.207
428.000	-23.391	-23.391	-3.041	-3.060	-23.378	-38.853	-128.473
429.000	-23.713	-23.713	-3.036	-3.059	-23.697	-39.091	-128.739
430.000	-24.047	-24.047	-3.032	-3.058	-24.029	-39.330	-129.004
431.000	-24.395	-24.395	-3.027	-3.057	-24.374	-39.569	-129.268
432.000	-24.757	-24.757	-3.023	-3.056	-24.733	-39.809	-129.532
433.000	-25.135	-25.135	-3.019	-3.056	-25.109	-40.050	-129.796
434.000	-25.530	-25.529	-3.015	-3.055	-25.501	-40.291	-130.059
435.000	-25.943	-25.943	-3.011	-3.054	-25.913	-40.533	-130.322
436.000	-26.377	-26.377	-3.007	-3.054	-26.345	-40.775	-130.584
437.000	-26.833	-26.834	-3.004	-3.053	-26.799	-41.019	-130.846
438.000	-27.316	-27.315	-3.000	-3.053	-27.279	-41.262	-131.107
439.000	-27.825	-27.825	-2.997	-3.052	-27.788	-41.506	-131.368
440.000	-28.367	-28.367	-2.994	-3.052	-28.328	-41.751	-131.628
441.000	-28.944	-28.944	-2.992	-3.051	-28.903	-41.996	-131.888
442.000	-29.562	-29.561	-2.989	-3.051	-29.520	-42.242	-132.147
443.000	-30.226	-30.226	-2.987	-3.051	-30.184	-42.488	-132.407
444.000	-30.945	-30.945	-2.985	-3.050	-30.902	-42.735	-132.665
445.000	-31.728	-31.727	-2.983	-3.050	-31.685	-42.982	-132.923
446.000	-32.587	-32.588	-2.981	-3.050	-32.543	-43.230	-133.181
447.000	-33.539	-33.539	-2.979	-3.049	-33.496	-43.478	-133.438
448.000	-34.606	-34.607	-2.978	-3.049	-34.564	-43.727	-133.695
449.000	-35.820	-35.819	-2.977	-3.049	-35.779	-43.976	-133.951
450.000	-37.223	-37.222	-2.976	-3.049	-37.185	-44.225	-134.207
451.000	-38.884	-38.884	-2.975	-3.049	-38.851	-44.475	-134.462
452.000	-40.911	-40.912	-2.974	-3.048	-40.886	-44.726	-134.717
453.000	-43.483	-43.484	-2.973	-3.048	-43.472	-44.977	-134.972
454.000	-46.857	-46.857	-2.973	-3.048	-46.880	-45.228	-135.226
455.000	-50.773	-50.772	-2.973	-3.048	-50.845	-45.480	-135.480
456.000	-50.920	-50.923	-2.973	-3.048	-50.927	-45.732	-135.733
457.000	-47.042	-47.045	-2.973	-3.048	-46.981	-45.985	-135.986
458.000	-43.629	-43.630	-2.974	-3.048	-43.555	-46.238	-136.238
459.000	-41.029	-41.029	-2.974	-3.048	-40.955	-46.491	-136.491
460.000	-38.985	-38.985	-2.975	-3.048	-38.913	-46.744	-136.742
465.000	-32.663	-32.664	-2.982	-3.048	-32.602	-48.018	-137.995
470.000	-29.023	-29.022	-2.994	-3.049	-28.973	-49.299	-139.239
475.000	-26.464	-26.464	-3.011	-3.050	-26.429	-50.587	-140.474
480.000	-24.492	-24.492	-3.032	-3.051	-24.475	-51.881	-141.701
485.000	-22.886	-22.886	-3.058	-3.052	-22.892	-53.179	-142.922
490.000	-21.531	-21.531	-3.090	-3.053	-21.564	-54.481	-144.136
495.000	-20.360	-20.360	-3.126	-3.055	-20.424	-55.786	-145.345
500.000	-19.327	-19.327	-3.167	-3.057	-19.428	-57.092	-146.549
510.000	-17.566	-17.566	-3.265	-3.061	-17.755	-59.705	-148.946

520.000	-16.096	-16.096	-3.383	-3.066	-16.393	-62.311	-151.334
530.000	-14.831	-14.831	-3.521	-3.073	-15.257	-64.903	-153.718
540.000	-13.718	-13.718	-3.680	-3.083	-14.292	-67.470	-156.102
550.000	-12.723	-12.723	-3.859	-3.095	-13.464	-70.004	-158.491
560.000	-11.822	-11.822	-4.059	-3.112	-12.749	-72.495	-160.884
570.000	-10.999	-10.999	-4.279	-3.134	-12.127	-74.932	-163.284
580.000	-10.243	-10.243	-4.520	-3.162	-11.587	-77.305	-165.689
590.000	-9.545	-9.545	-4.779	-3.197	-11.117	-79.603	-168.096
600.000	-8.898	-8.898	-5.058	-3.241	-10.710	-81.814	-170.502
625.000	-7.479	-7.479	-5.832	-3.387	-9.923	-86.889	-176.477
650.000	-6.301	-6.301	-6.700	-3.593	-9.406	-91.188	-177.679
675.000	-5.327	-5.327	-7.636	-3.858	-9.100	-94.578	-172.061
700.000	-4.527	-4.527	-8.608	-4.173	-8.958	-96.978	-166.749
725.000	-3.873	-3.873	-9.582	-4.531	-8.941	-98.365	-161.797
750.000	-3.337	-3.337	-10.522	-4.919	-9.018	-98.787	-157.230

FIG. 6 C